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The Relation Between Process Management and Innovation – A comparison of the IT and Manufacturing Industries

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Abstract This study investigates whether there are major differences between process management and innovation between the IT and more traditional industries. Although both industries are quite similar, the research results show that the IT industry is more innovative in comparison to more traditional industries. The traditional industries are more risk averse towards new technologies, which makes them less innovative than the IT industry.

Keywords: • Business Process Management • maturity models • innovation value chain • innovation adoption • IT industry • manufacturing •

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1 Introduction

During the last few years there have been many changes for organisations on a global level. Nowadays, through globalisation and the internet, markets change quicker and organisations have a limited amount of time to adopt new trends or change their business models. Therefore, the European Commission (2017) states that innovation is critical in order to improve existing products, services and processes or develop new ones that add value to an organization and increase Europe's competitiveness on a global economic level. However, besides innovation, organizations are also focusing more and more on the efficiency and effectivity of their processes and therefore business process management (BPM) is getting more attention (Plattfaut et al., 2011; Ravesteyn et al., 2012; Gabryelczyk, 2016). BPM plays a vital role in addressing the priorities of current Chief Information Officers (CIO) because BPM is a key instrument in managing and improving organizational processes with information systems (Gartner, 2010; Plattfaut et al., 2011).

Scientific studies that find that BPM maturity models support organizational performance are not new (Rosemann & de Bruin, 2005; Fisher, 2004; Davenport & Short, 1990). However recent research shows that BPM could also be an enabler to the innovation level of an organization (Vom Brocke et al., 2016). What is not described in these studies is whether there is a difference in how BPM and innovation are related between different industries. A relatively young industry such as IT might be expected to be a lot more innovative compared to more traditional industries such as manufacturing. Therefore, the objective of this study is to determine if such a difference exists. The research question for this study is as follows:

What are the differences in the relation between BPM and innovation in a comparison between the IT industry and the manufacturing industry?

This comparison is made in order to create a broader understanding as to whether and, if so, why the software industry is more innovative when compared to more traditional industries. To be able to analyse this research question a quantitative study is performed based on data collected in three IT companies and two manufacturing companies (in respectively the coffee and the jewellery industry).

The remainder of this paper is organized as follows, the next section will discuss the literature on the main constructs in our study, followed by the research method in section 3. Section 4 continues with the results and the paper concludes with the main findings in section 5.

2 Literature

The theoretical framework (see section 2.4, figure 1) of this study consists of three main constructs: Business Process Management Maturity (BPMM), innovation value chain (IVC) and innovation adoption (IA). In this section each of these constructs is discussed in more detail. For the literature study Google Scholar and the databases of Science Direct, Springer, and Wiley Online Library are used in combination with the following keywords: 'BPMM and innovation', 'Business process management and innovation', 'innovation value chain', 'innovation adoption', 'innovation', 'process management and innovation'. The papers that were found were accordingly analysed to determine the relevancy, the findings are discussed below.

2.1 Business process management maturity

Business Process Management is a management methodology that exists at different organizational levels on which processes are assessed stepwise with the goal to improve the capabilities of the organisation (van Looy et al., 2013). The maturity of BPM is studied by Rosemann & de Bruin (2005), who created one of the first widely accepted BPMM models. This model is multi-dimensional since it analyses different factors, stages and contexts (Rosemann & de Bruin, 2005). This is in line with Vom Brocke et al. (2016) whom argue that most models in BPM have a "one-size-fits-all approach", which causes problems that will not account for the situational contexts necessary to gain benefits. Furthermore, Vom Brocke et al. (2016) state that business process management supports an organization in their innovativeness.

Rosemann & de Bruin (2005) based the factors of their model on BPM critical success factors, which consist of independent and dependent variables. The assumption is that the higher the score on these variables, the higher the level of success in BPMM. Moreover, they state that an individual organisation should translate process success into the most important BPM-independent success measures. Furthermore, Rosemann & de Bruin (2005) find that there is not a standardized toolkit for every organisation to put BPMM into practice.

Fisher (2004) states that a one-dimensional five-stage model for BPMM is not enough. Fisher's (2004) model exists of two parts, the first part is referred to as the "Five Levers of Change", which are used to assess the capabilities of an organisation. The second dimension also exists of five factors, representing the five maturity stages of BPMM. This dimension is used to measure the performance of the "Five Levers of Change". Fisher (2004) measures BPMM by using two different measure points. In contrast, the model of Rosemann & de Bruin (2005) measures BPMM on three levels (stage, factor and scope/context). Evidence is yet to be provided to see whether a multi-factor model is superior when compared to a two-factor model. Finally, Fisher (2004) concludes that the advantages of using BPMM models for companies is that they will improve the efficiency

and lower their costs which, in turn, could result in higher profits. All these advantages combined provide companies a competitive advantage.

Another BPPM model is constructed by Ravesteyn et al. (2012) whom used the Capability Maturity Model Integrated (CMMI) as a foundation to establish seven maturity dimensions. The CMMI model has also been used by Rosemann and colleagues in their research (Rosemann et al., 2004; Rosemann & de Bruin, 2005; Rosemann et al., 2006). As the BPMM model by Ravesteyn et al. (2012) is extensively used to research the relation to process performance this model is applied in the conceptual model of this study, here performance is substituted with innovation. In order to measure the level of BPM maturity within an organization Ravesteyn et al. (2012) used 37 items (BPM capabilities) divided over the seven dimensions. To measure the maturity level of the 37 BPM capabilities a Likert scale from 1 (low) – 5 (high) is used.

2.2 Innovation value chain

Hansen & Birkinshaw (2007) developed the innovation value chain framework. Their approach requires executives to have an end-to-end view of the innovations in their companies. Their framework will also force executives to focus on the weakest links in the innovation process of the company. The first phase is to "Generate ideas", come up with new products or services, either from within the company or outside the company; "Convert ideas" is the second phase. At this stage the company has selected the ideas, collected the funds and started the development of the product. The third and final phase is to "diffuse" the developed product or service, this means that the developed product or service concept is used in the organisation or launched in the market. Hansen & Birkinshaw (2007) state that when a manager wishes to use these three phases of the innovation value chain the manager has to focus on six critical tasks: "Internal sourcing, Cross-unit sourcing, External sourcing, Selection, Development and Company wide spread of the idea" (Hansen & Birkinshaw, 2007, p. 122).

Ganotakis & Love's (2012) state that the company's resources have a significant influence on the innovation process and on the growth of the company. Ganotakis & Love's (2012), find three main implications in their research: first, the innovation value chain makes it possible to identify the factors that enable a company's level for growth and productivity when compared to new technological based firms. Secondly, companies which develop and market disruptive innovations show fast growth leading to better productivity and performance. The third and last implication is that the innovation value chain makes it possible to identify the innovation behaviour, focusing on the important role of R&D which influences the success of innovation.

Based on the studies by Hansen & Birkinshaw (2007) and Ganotakis & Love (2012) it can be concluded that the innovation value chain is a method that explains the process of innovation from generating ideas to converting ideas and subsequently its diffusion, which leads to new business opportunities in order to generate new revenues.

Furthermore, this approach also helps to draw the attention to an organisation's strengths and weaknesses in the innovation process.

2.3 Innovation adoption

Damanpour & Wischnevsky (2006) distinguish innovation-generation (as described above as part of IVC) from innovation-adopting. When organisations use innovation adoption the purpose is to change the organisation in such a way that it becomes more effective and develops a more competitive mind set, in order to adapt more easily to new trends in the market.

In their research Hameed et al.'s (2012) try to determine the process of IT adoption. Moreover, Al-Jabri & Sohail (2012) developed six hypothesises to show which factors have a profound influence on IT adoption. Both studies support each other: Hameed et al.'s (2012) model provides a general overview and Al-Jabri & Sohail's (2012) model offers a more specific focus on a few elements influencing IT adoption.

In an earlier study on the adoption of internet banking, Tan & Teo (2000) concluded that subjective norms lack a significant relationship with intentions. Perceived behavioural control and attitudinal factors can be used to predict the intentions (in this case to adopt internet banking services). They describe three factors (Attitude to innovation, Subjective norms, and Perceived behavioural control) which influence someone's or an organization's intention to adopt a new product or service. This is similar to the study by Al-Jabri & Sohail's (2012) in which it is concluded that the six factors together provide a solid measurement tool for innovation adoption.

2.4 Conceptual model

Derived from the theory and concepts described in the literature study above, the conceptual model (figure 1) for this research consists of three main constructs: BPM maturity, innovation value chain and innovation adoption (variables). For BPM maturity, the framework has the seven dimensions with corresponding BPM capabilities (theorems) from Ravesteyn et al. (2012). The capabilities are used as input in order to develop survey questions to measure each dimension.

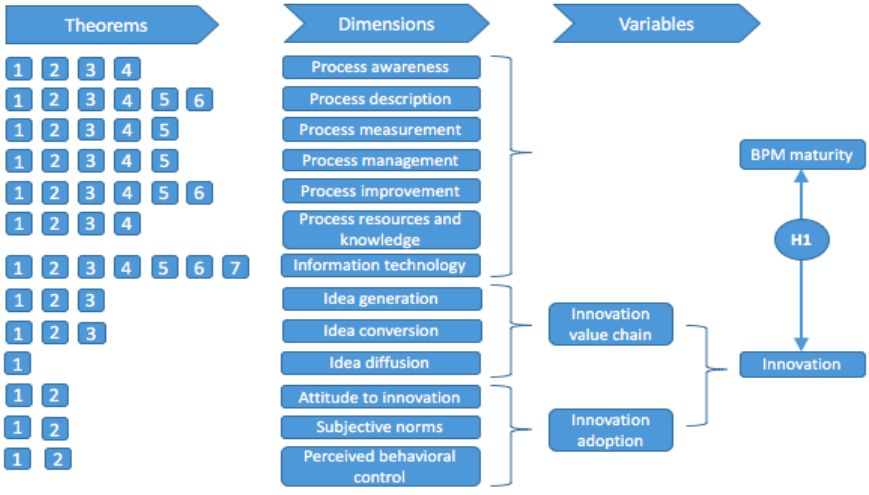

Figure 1: Conceptual model

The innovation construct in the conceptual model is split up into the two constructs innovation value chain and innovation adoption. The innovation value chain is very focused on the analysis of how innovations come up, whereas innovation adoption focuses on acceptance of the innovation by the final user or adoption of new innovations by the organization. This co-dependency results in the assumption that both theories strengthen each other. Finally, based on this reasoning, the hypothesis (H1) is that there is a positive relation between the BPM maturity and Innovation.

3 Research Method

3.1 Data collection

For this study data is used that has been collected as part of a larger research project on BPM and Innovation. For this an online survey tool was used as this makes it very convenient for the respondents to answer the questions in their own time. The data is collected across cultures and in different countries at seven companies. Three out of seven were located in The Netherlands and the other companies were located in Austria, Belgium, China and Ireland. Most of the companies are active in the software industry whereas the other companies are active in manufacturing (such as jewellery and coffee) or the finance sector.

The data was collected by a team of six researchers. To ensure the data was collected in the same manner a coding manual was developed to ensure all collected data had the same definitions. In total 200 completed surveys have been collected. In all organisations

the survey has been filled in across several departments by C-level to middle management and operational positions.

3.1.1 The questionnaire

The survey was constructed by using the structure of the conceptual model. As explained above, the conceptual model shows how many items are used for every dimension of BPMM and for the two innovation constructs. The survey contained 50 questions on the main concepts, 37 questions were divided over the seven dimensions to measure the level of BPM maturity and 13 questions addressed the innovation part. For each statement a Likert scale from 1 to 5 was used to indicate whether the participants strongly disagreed, strongly agreed or stayed neutral. In addition to that, there were also some general questions concerning how knowledgeable the participants were regarding BPM, how the respondents would define BPM, and what position they had within their organisation.

3.1.2 Validity of the research instrument

To analyse the validity of the constructs, a Varimax method was used within the factor analysis, which was developed by Kaiser (1958). A rotation factor analysis is the most commonly used method in this type of analysis (Abdi , 2003). The results, of the factor analysis showed that only six components were recognised for BPMM despite the fact that the BPMM construct consists of seven dimensions in the conceptual model. The variable innovation showed three components and there were only two in the conceptual model (innovation value chain and innovation adoption). Based on this analysis it could be argued that the conceptual model could benefit from adjustments, since not all components were recognised. Therefore, a second analysis was performed: the Cronbach alpha was used to determine the reliability of separate components (table 1). Tavakol & Dennick (2011) suggest in their article that a Cronbach alpha should be in the range of 0.70 to 0.95 (Nunnally & Bernstein, 1994; Bland & Altman, 1997; DeVellis, 2003). However, the recommended maximum value is 0.90 (Streiner, 2003). Furthermore, a low indication could be influenced by the number of questions asked for one item or poor interrelatedness between the items (Tavakol & Dennick, 2011). The results in Table 1 showed that all dimensions have a value above the minimum of 0.70 and did not exceed the score of 0.90, which indicated that the results of the collected data were statically reliable.

Table 1: Cornbach Alpha

Dimensions	Cronbach's Alpha	N of Items
Process awareness	.750	4
Process description	.895	6
Process measurement	.861	5
Management of processes	.827	5
Process improvement	.830	6
Process knowledge & resources	.745	4
Information technology	.884	7
Innovation value chain	.841	7
Innovation adoption	.735	6

3.1.3 Analysis

As Cohen (1992) states that a T-test is widely used to compare means and that it also shows whether the difference between two elements is significant or not, a T-test is conducted to compare the survey results of two sets of companies (IT and manufacturing). This is done by adding three variables in SPSS: company name, industry branch and bucket. This last variable is used to define the groups. Three companies are labelled IT and two were labelled OLD (these are the manufacturer of coffee beans and that of jewellery).

4 Analysis Results

4.1 Level of knowledge on BPM

First the respondents were asked to assess their knowledge of BPM. For this they could choose between four different levels. Out of 200 respondents (group IT: 114, group OLD: 61, another 25 respondents are out of scope as they don't fit into this classification) 35% (IT: 33%, OLD: 33%) had little to no knowledge and practical experience with BPM, 27% (IT: 32%, OLD: 21%) had some knowledge of BPM, but no practical experience, whereas 29% (IT: 29%, OLD: 34%) had some knowledge and limited practical experience with BPM (participated in 1 to 3 projects). Only 10% (IT: 6%, OLD: 11%) of all the respondents had both knowledge and practical experience with BPM (>3 projects). The percentages out of 200 respondents show that a small group of respondents was very experienced and is considered to have a high level of knowledge on BPM. Furthermore, the category OLD shows a higher percentage in this level in comparison to IT. It must be noted that the majority of respondents either had no knowledge of BPM or a limited amount of knowledge and practical experience with BPM, this might have influenced the results.

4.2 A comparison of IT and Manufacturing

Table 2 shows the mean scores for the BPM maturity dimensions between IT and OLD. The smallest difference between both groups is for measurement of process, meaning that both groups use performance indicators that assess and check processes and use this to improve processes (Ravesteyn et al., 2012). Additionally, BPM maturity dimensions' process awareness, process description and management of processes show that IT has a higher maturity level in comparison to the companies in the OLD catagory. From these results, it can be concluded that group IT is more aware of the impact that processes, process descriptions and process owners have within their organisation and they incorporate this in their strategy (Ravesteyn et al., 2012). The results also show that group OLD has a higher level of maturity in dimensions' process improvements and process resources and knowledge. This means that group OLD organizations try to improve their processes more often and also have a support system for process improvements in place. Group OLD also has more resources and employees with process knowledge. Finally, the information technology dimension shows a large difference between the two groups. This indicates that IT companies make more use of information technology to design and carry out processes to produce real-time measurement information in comparison to the manufacturing companies.

Table 2: Comparison on BPM maturity dimensions

Groups	IT	OLD
N	114	61
Process awareness	3,4934	3,4221
Process description	3,2456	3,1639
Measurement of processes	3,3965	3,3770
Management of processes	3,3386	3,2623
Process improvements	3,1637	3,2732
Process knowledge and resources	3,2281	3,3361
Information technology	3,5288	3,1944
BPM Maturity	3,3421	3,2899

In comparison to the findings described above, the results of the T-test analysis (Table 3) only show a significant difference on information technology (.010) with 95% confidence interval of the difference.

Table 3: T-Test on BPM maturity dimensions

Independent Samples Test			
BPM dimensions		Sig. (2-tailed)	Mean Difference
Process awareness	Equal variances assumed	.525	.07129
Process description	Equal variances assumed	.534	.08168
Measurement of processes	Equal variances assumed	.876	.01944
Management of processes	Equal variances assumed	.524	.07630
Process improvements	Equal variances assumed	.305	-.10948
Process knowledge and resources	Equal variances assumed	.335	-.10800
Information technology	Equal variances assumed	.010	.33444
BPM Maturity	Equal variances assumed	.583	.05224

Table 4, shows all means of the innovation dimensions. The results of the phases of the innovation value chain construct show that there is a small difference in regards to idea generation for both groups: both groups tend to agree that their employees are good at creating ideas on their own, but also across the organization. Furthermore, the results show that group IT has a higher mean on idea conversion whereas group OLD has a higher mean on idea diffusion. From these results, it might be concluded that group IT tends to be better in selecting, screening, and funding ideas as well as turn ideas into a minimum viable product, whereas group OLD tends to be better in getting new ideas out of the organisation.

Table 4: Comparison on Innovation

Groups	IT	OLD
N	114	61
Idea generation	3,5702	3,5628
Idea conversion	3,3392	3,2787
Idea diffusion	3,2719	3,3934
Attitude to innovation	3,6623	3,2295
Subjective norms	4,0658	4,0328
Perceived behavioural control	3,2149	2,8770
Innovation value chain	3,4286	3,4169
Innovation adoption	3,6477	3,3798
Innovation	3,5381	3,3983

The results of Table 4 also show that group IT has a higher mean on attitude to innovation and perceived behavioural control in comparison to group OLD. This shows that group IT agrees that the latest innovations benefit their organization and believe that it does not present any risk to their organization. In addition, group IT also scores higher on perceived behavioural control, which indicates that software organizations tend to use the latest innovations, but also agree to have time, money and resources to keep using these latest innovations. Furthermore, based on the subsequent T-test (Table 5), only the difference on attitude to innovation and perceived behavioural control show significance between the two categories (with 95% confidence interval). Moreover, the smallest difference between both groups is created by subjective norms, within the innovation adoption construct, which means that both groups use the latest innovation to stay competitive in the market. On top of this, customers also expect both groups to use the latest innovations.

Table 5: T-test Innovation dimensions

Independent Samples Test			
Innovation dimensions		Sig. (2-tailed)	Mean Difference
Idea generation	Equal variances assumed	.951	.00733
Idea conversion	Equal variances assumed	.610	.06049
Idea diffusion	Equal variances assumed	.455	-.12151
Attitude to innovation	Equal variances assumed	.000	.43277
Subjective norms	Equal variances assumed	.794	.03300
Perceived behavioural control	Equal variances assumed	.015	.33786
Innovation value chain	Equal variances assumed	.914	.01171
Innovation adoption	Equal variances assumed	.008	.26788
Innovation	Equal variances assumed	.116	.13979

As a result of the analysis described above it is possible to conclude that group IT only differs on two dimensions of the conceptual model when compared to other companies. This indicates that, based on this analysis, IT companies tend to be more innovative than manufacturing companies. For traditional organisations this is confirmed by Rosemann (2012) and vom Brocke et al. (2016), who both suggest that BPM does not support the innovation process because it only provides methods and techniques, which support the development of a structure to analyse an organisation.

5 Conclusion

5.1 Main findings

In this research the objective was to answer the question:

What are the differences in the relation between BPM and innovation in a comparison between the IT industry and the manufacturing industry?

Based on our analysis of the differences between IT industry (software companies) and manufacturing (coffee and jewellery companies) we find that these industries are very similar when it comes to the relation between BPM and Innovation. They only differ significantly on the BPM dimension information technology and the innovation adoption dimensions' attitude to innovation and perceived behavioural control. As Tan & Teo (2000) concluded in their study on mobile banking adoption that perceived behavioural control and attitudinal factors are the key elements that can be used to predict the intention to adopt a new technology, it might be concluded that the IT industry is a step ahead of

the manufacturing industry in terms of using information technology and are also able to adapted more quickly to new innovations that are beneficial to their organization, this is something which is to be expected given the nature of IT companies.

5.2 Implications

The IT industry and manufacturing industry are surprisingly similar. However, based on this study we find that the manufacturing industry should put more effort towards adopting new technologies in order to be more innovative. For example, organizations can invest more in the latest technologies that could produce real-time measurement information in support of the daily business operations. Besides, investing in new technologies it is also essential to invest in the knowledge of people in order to get the optimal performance out of the latest technologies.

5.3 Limitations

A limitation of this study is that data is collected across different industries but also from different countries within Europe and China. Thus, cultural differences could have influenced the answers as Lee et al. (2002) showed that different cultures have different perceptions, therefore our scale for answering the statements could be interpreted differently. Additionally, in this study a Likert scale is used to measure all the dimensions of BPM and innovation based on the most well-known scale from 1 (strongly disagree) to 5 (strongly agree) (Likert, 1932; Gliem & Gliem, 2003), however, literature suggests that a five-point Likert scale is a minimum but it is better to have a broader scale (Allen & Seaman, 2007). Hinkin (1995) researched scale developments and within his review a majority of the researched studies used a five-point scale. Although, the second biggest group used a seven-point scale. According to these results the cultural influence on the Likert scale and the scale-size are arguable and therefore seen as a limitation in this study. Furthermore, in this study a T-test is conducted to investigated the significant differences based on the means between two constructs. As there are also other techniques available to analyze the data, this is also considered as a limitation.

5.4 Recommendations for future research

This study has gone some way towards enhancing the understanding of the relationship between BPM and innovation. The conceptual model still needs some refinement because the factor analysis only recognised six out seven BPM dimensions and for innovation three instead of two dimensions. Moreover, more research is required to improve the understanding of the relationship between BPM and innovation within and between different organizations and sectors as well as across cultures.

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